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REPORT

ON THE

THE

PRINCIPLES OF THE PRESENT SYSTEM

OF

THEORY AND PRACTICE, AND ITS
APPLICATION TO THE

OF

THEORY AND PRACTICE



U. S. ARMY

OFFICE OF THE ADJUTANT GENERAL, WASHINGTON, D. C.

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REPORT
OF THE
COMMITTEE APPOINTED TO INQUIRE INTO
THE
EFFECT ON HEALTH OF THE PRESENT SYSTEM
OF
CARRYING THE ACCOUTREMENTS, AMMUNITION, AND KIT
OF INFANTRY SOLDIERS,
AND
DRILL, &c. OF RECRUITS.



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FOR HER MAJESTY'S STATIONERY OFFICE.

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Major-General Rum-
ley, Inspr.-Genl. of
Infantry; Col. Sir A.
Horsford, K.C.B.,
Depy.-Adjt.-General;
Dr. Logan, Inspr.-
General of Hospitals;
Dr. Parkes, Army
Medical School,
Netley.

SIR,

War Office, May 2, 1862. 4.

EARL DE GREY AND RIPON having decided, with the concurrence of His Royal Highness the Field Marshal Commanding-in-Chief, to appoint a Committee consisting of the Officers named in the margin, under your presidency, for the purpose of considering how far the large amount of lung and heart disease prevailing among soldiers of less than two years' service is attributable to the present system of drill and accoutrements, and of reporting as to the amount of drill to which recruits should be subjected on first joining the Army, and the pattern of accoutrements and knapsacks best adapted to obviate the evils complained of,—I am directed to apprise you of the same, and to state that the members of the Committee have been requested to attend to any instructions they may receive from you as to the time and place of meeting, and that accommodation can be afforded for such meetings in this office.

I am,

Sir,

Your obedient servant,

(Signed) EDWARD LUGARD.

Major General Eyre,

Commanding H. M. Forces, Chatham.

In a subsequent letter, the Committtee were directed to take into consideration the mode in which the Field Companion, borne by serjeants of the Army Hospital Corps, can be best carried.

R E P O R T .

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TO THE RIGHT HONOURABLE THE EARL DE GREY AND RIPON, SECRETARY
OF STATE FOR WAR, &c., &c.

THE Committee appointed "To consider how far the large amount of Lung and Heart Disease prevailing among Soldiers of less than two years' service is attributable to the present system of drill and accoutrements, and to report as to the amount of drill to which Recruits should be subjected on first joining the Army, and the pattern of accoutrements and knapsacks best adapted to obviate the evils complained of, and also the means by which the 'Field Companion' (which is borne by Serjeants of the Army Hospital Corps) can be best carried, (see letter from Professor Longmore, Appendix No. 5,)" have the honor to make the following Report:—

The subjects which the Committee had to consider may be conveniently divided according to the paragraphs in the letter of instructions quoted in the margin.

Letter from
Sir E. Lugard,
2d May 1864.

I.—THE AMOUNT OF HEART AND LUNG DISEASE PREVAILING AMONG SOLDIERS UNDER TWO YEARS' SERVICE.

(a.) *As regards Heart Disease.*—To enable us to answer this question, we have had before us some returns from the Invaliding Establishment at Fort Pitt during the years 1860–62, and a return prepared by the Statistical Branch of the Army Medical Department for the years 1861–63 inclusive (see Appendix No. 1); unfortunately this return refers only to ages and not to length of service.

The Fort Pitt returns show that in the men under two years' service, one man in every seven invalids was discharged for heart disease; the statistical return from the Medical Department shows that in men under 20 years of age, (who may be assumed to have less than two years' service,) one invalid out of every 5.45 invalids was discharged for heart disease.

The two returns are fairly accordant, the last giving, however, a greater number of heart cases, which may arise from only a portion of the invalids of the army passing through Fort Pitt.

There certainly appears to be a large relative proportion of heart cases among invalids of two years' service or under; and when it is remembered that every recruit is examined by a medical officer, and is then presumably entirely free from heart disease, it is difficult to avoid conjecturing that there must be some causes acting in early army life which give rise to affections of the heart.

But this conjecture could only become a certainty if we could know how many healthy young men, of 18 or 19 years of age, and free from heart disease, as the recruit is supposed to be, would become affected with heart disease within two years, supposing that they remained in civil life.

Unfortunately we have no means of getting this knowledge, as there are no available statistics of the amount of heart disease among the civil population. We can only fall back upon a general impression among the medical profession, which is, we are informed, that, apart from rheumatic fever, heart diseases of a permanent character do not commonly originate in young men of 18 or 20 years of age. Now, rheumatic fever appears, from some observations of Professor Maclean's, not to be a common cause of heart disease among young soldiers, and therefore they ought to be as free from heart disease as young civilians of the same ages are believed to be.

We can consider the point in another way.

Are heart diseases more common among young than old soldiers as causes of invaliding?

The Fort Pitt returns give 1 in 12·98 as the proportion of heart cases to invalids of all ages, while, as already said, in invalids under two years' service it was 1 in 7.

The statistical return, sent to us by the Director General of the Army Medical Department, gives the following average for the three years 1861-2-3:

Heart cases to total invalids under 20 years	-	-	1 in 5·45
„ „ 20 to 24 „	-	-	1 in 6·44
„ „ 25 „ upwards	-	-	1 in 8

The two returns are not strictly comparable, as many of the invalids over 20 years of age may be under two years' service; but still this last return shows that the relative proportion of heart cases decreases with age. This must be either from an excess of heart cases among the young, or from an excess of other diseases among the older soldiers, which reduces the relative amount of heart disease.

To test this, we must take the absolute number of heart cases furnished by a certain number of men. We find, on the average of the three years 1861-63, that 1,000 men of the under-mentioned ages gave:—

Invalids from heart disease:

Under 20 years of age	-	-	2·19
20 to 24 „	-	-	4·57
25 and upwards	-	-	5·02

The significance of these numbers is not obvious at first sight. But it will be seen, on reflection, that the men aged from 20 to 24 give almost as many heart cases as the men aged 25 and upwards.

Many of the men in the last class must have been aged 25, 30, 35, or even 40 years. Now, as apart from rheumatic fever the prevalence of heart disease increases with age, we should have anticipated that the men over 25 would have shown a great excess of heart cases over the men of the ages 20 to 24, whereas they only show a difference of $\frac{1}{2}$ per cent.

The very slight increase of heart cases with age, may be seen by comparing it with the increase from all causes. As age advances the action of the causes of invaliding regularly advances also. Thus 1,000 men at the under-mentioned ages give:—

Invalids from all causes:

Under 20 years	-	-	11·93
20 to 24	-	-	29·45
25 and upwards	-	-	39·40

Compare the advance from 29·45 to 39·40 with that from 4·57 to 5·02. If the two had been equal the invaliding over 25 years of age would have been for heart diseases 6·1 instead of 5·02.

We believe, then, that there is an excess of heart cases among young soldiers, but then arises another very important question. Is not the number of heart cases among soldiers at all ages very great?

Is it not larger than among the male civil population of the same ages? We regret extremely that the imperfection of the civil statistics does not permit us to answer this last question; but as regards the number of heart cases among the soldiers, the following extract from a lecture, delivered by Professor Maclean, of the Army Medical School, in the Royal United Service Institution, on this very subject, will show how prevalent these diseases are.

Dr. Maclean says: “From the date of my assuming charge of the Medical Division at Fort Pitt, in April 1861, to the end of last year (1862), no less than 883 cases of disease of the circulatory system, or in other words a number nearly equal to the strength of a battalion—have passed under my observation and been lost to the service, and this from one class of disease; the great bulk of the cases being young men returned to the civil population (that is, cast upon their parishes), and incapable of earning their bread in any active employment.”

These numbers, it must be remembered, represent only a portion of the actual invalids, as the invalids from the Guards, the Royal Artillery, and the troops in Ireland are not included.

Now, certainly, this does appear a very large number; and even if it were not greater than what would occur in civil life, which we doubt extremely, it would still require us to endeavour to determine the causes and see if there may not be some means of saving the State from so great a loss, and the parishes from so great a burden.

(b.) *As regards Lung Disease.*—To answer this question we have only the invaliding returns from Fort Pitt for two years (1860–62). It appears that of men under two years' service 29·99 per cent., or almost one man in every three, were invalids for lung disease (chiefly consumption), while in invalids of all ages only 19·8 per cent., or one man in every five, was invalided for lung disease.

We have no statistics among the civil population which can properly compare with these numbers, as the civil statistics merely record the deaths, but there is very little, or, indeed, no doubt that lung diseases are much more common among soldiers than among civilians, and the above numbers seem to show that they are more common among young than old soldiers.

It appears from the Fort Pitt returns that in two years 304 invalids under two years' service were discharged for lung disease.

Now, every one of these men was carefully examined on enlistment. Is it conceivable that in that short space of time so many cases should have originated unless there were some conditions acting unfavourably on the health?

We are not prepared to state what part the pressure of accoutrements, and forced exercise under unfavourable conditions, played in the production of this lung disease, but it is only reasonable to believe it had some share.

II.—WHAT ARE THE CAUSES OF THIS EXCESS OF HEART AND LUNG DISEASE?

We now proceed to the second part of the inquiry. There being evidently a great number of heart and lung diseases among soldiers, probably more than among civilians, and such cases being apparently in greater relative amount among young soldiers, what are the causes of such prevalence?

As respects heart disease, the question has been carefully examined by Professor Maclean, a copy of whose lecture at the Royal United Service Institution we annex (see Appendix 2).

After examining into the various possible causes, Dr. Maclean concludes that the most probable reason is that the young soldier is called upon to make much exertion under unfavourable conditions.

During exertion, anything which constricts the lungs, or impedes the action of the heart, tends to produce disease of those organs, and especially so at an early age, when the bones and cartilages are not matured and yield when pressure is made upon them.

The young soldier of 18 or 20 years of age is but imperfectly grown and developed; many of the bones are not united, and an amount of pressure which would be unfelt by the older man may be very injurious to him.

In order to see if the recruit is overworked, Major-General Rumley obtained returns from all the dépôt battalions, showing the amount of drill to which the recruit is subject. We have prepared an abstract of these documents (see Appendix 3).

From these returns it would appear that the system of recruit drill is nearly uniform at the several dépôts.

About three hours a day are occupied in drill, and this is divided into three periods, viz., one hour from half-past 8 to half-past 9; again from half-past 10 to half-past 11, from 11 to 12, and again from 2 to 3 or from 2·30 to 3·30.

In one or two cases the periods are longer, but in no case exceed four hours.

The knapsacks are worn in most cases only during the last weeks of drill, and then usually only for an hour daily.

The drill extends over a period of about two months, when the recruit goes to rifle drill.

During rifle drill it appears that knapsacks are generally worn, and from this time the pack is carried by the young as by the older soldiers.

In addition to drill in some stations the recruits go through a course of gymnastic instruction.

We do not perceive that the recruit is made to undergo any excessive labour, or is drilled in any way which is likely to injure him. Three hours' daily drilling is certainly not excessive, and the pack is seldom worn.

It is not therefore to the early drill period but to the subsequent time, when the recruit has joined the ranks and performs the same duties as the older soldiers, that we must look for the causes affecting him, if these are to be found in overwork or in the use of improper accoutrements and weights.

This is, in fact, indicated by the result of the Fort Pitt returns, which show that there are more heart and lung cases among the young soldiers during their second than during their first year's service.

The mode in which diseases of the heart and in a less degree of the lungs are supposed to be produced by exertion carried on under unfavourable conditions is, as described by the medical members of the Committee, as follows:—

During exertion the movements of the chest increase very greatly; deeper breathings are made, the diameter of the chest enlarges in all directions, causing greater expansion of the lungs; the blood flows through the lungs much more rapidly, and the changes in it, and the evolution of carbonic acid, are trebled or quadrupled in amount; the heart acts much more quickly and forcibly. If anything destroys the equilibrium between the powerful action of the heart and the capacity of the lungs to receive the blood propelled into them by the heart, the necessary consequence is an accumulation of blood in the cavities and walls of the heart, which leads to an imperfect action of that organ and to organic changes in its cavities or walls. The special heart disease from which the young soldiers suffer is not, we are informed, disease of the valves, but an extreme excitability of the heart, combined with some but not great enlargement. During rest a heart of this kind beats easily, but on the least exertion its action becomes extremely quick, then weak and perhaps irregular, and the man becomes breathless.

Now this condition is just that which we should anticipate from the causes in action. The young soldier's ribs and breastbone, while still soft and pliable, are prevented from proper movement by tight-fitting clothes and by the straps of accoutrements and pack. Of these the crossbelt bearing the pouch is the most objectionable, as it passes across the chest and impedes the movement forward of the breastbone. The waist belt, also, if too tight, hinders the expansion of the lower ribs. The knapsack straps are less hurtful in this way, but they also press to some extent on the collar bone and the first ribs.

It will be seen, therefore, that there is a combination of actions all leading to the same result.

The mature soldier, with his bones all formed and his muscles full grown and strong, may perhaps bear these constrictions without injury, but not so the young man. It is probable, however, that more or less injury is done to all.

One fact has been mentioned to us of some significance. Of late years the attention of medical men has been much directed to a peculiar appearance on the heart.

It is called the "white spot," and is a round white patch seated on the external coat of the heart. It is now believed to be simply the result of pressure on the heart. In soldiers this spot is exceedingly common, in fact almost universal, as has been shown by the careful post-mortem examinations made at Fort Pitt and Netley by Professors Aitken and Maclean. These gentlemen are strongly inclined to believe, though at present they desire a larger collection of facts before they are quite certain, that this sign of improper pressure is much more common among soldiers than among civilians.

With respect especially to diseases of the lungs, some other causes have been mentioned to us which may be in action. The recruit and young soldier is a good deal exposed to cold during drill, and in the opinion of the medical officers his clothes are not sufficiently warm. It is therefore supposed that he may catch cold more frequently than he would otherwise do, and that in some cases this may bring on more serious diseases.

By the latest clothing warrant (2nd January 1865) the soldier's kit may contain Three *cotton* or two *flannel* shirts. The latter article might be made compulsory for recruits.

III.—PATTERN OF ACCOUTREMENTS AND KNAPSACKS.

We proceed now to the third point, viz., to consider what is "the best pattern" of accoutrements and knapsacks adapted to obviate the evils complained of."

We may first say, that the effect on the health of the young soldiers is not the only objectionable point in the present accoutrements and packs. They are irksome and uncomfortable to all. The cross-belt, when 40 or 60 rounds of ammunition are carried, is not only felt tightly across the chest, but the pouch moves and sometimes bumps against the man; the knapsack straps cut under the arms, and cause swelling and numbness of the hands. So great are the discomforts and so considerable is the loss of rapidity and strength of movement consequent on the pressure thus exerted on the chest and on so many muscles, nerves, and vessels, that all the nations in Europe but ourselves have of late years altered their system of accoutrements and packs. Various propositions have been before our own Government for a number of years, but none have been adopted, chiefly we conceive because none have come up to the requirements of a perfect system.

In fact, so many are the difficulties in getting a perfect pack, that there is not one to which some objection may not be taken.

But there is no doubt a great difference in point of ease in different systems. The present regulation pattern we conceive to be the worst of all, and if we cannot recommend an absolutely perfect knapsack and set of accoutrements, that is no reason why we should be content with the present pattern.

We have had under our consideration all the packs and accoutrements we could collect,* and have also had interviews with several inventors, and have perused various reports.† We have spent much time and spared no trouble in fitting and testing the various systems, with a view of selecting such plans as appeared most worthy of a practical trial.

In Appendix No. 4, we have given a list of all the packs we have examined, and have added a few words stating the reasons why we have not selected them.

In our selection we have been guided by the following rules :—

(a.) That the accoutrements and packs should be free from all chance of medical objection on the score of pressure or constriction on the chest, or on muscles, or blood vessels.

(b.) That they should be simple, durable, and easily put on and taken off, and not objectionable for military reasons.

The conditions of simplicity and durability excluded some packs in which metal rods were used. If mechanical appliances are permitted, it is not difficult to carry considerable weights without injury; but then there is the disadvantage of the apparatus being liable to break. In two cases we have admitted packs in which metal supports are used, viz., Lieutenant-Colonel Carter's and Colonel Sir T. Troubridge's system. In both these cases the risks of breakage of rods are, we are informed, not great, and the advantages of the plans are great, so that we have deviated from our rule and recommended a practical trial of them.

It is essential to consider at the same time the system of carrying the packs containing the kit, the pouch containing the ammunition, the great coat, and the canteen.

The consideration of how the blanket, water bottle, haversack, and provisions are to be carried is of less moment, as there is little difficulty in arranging for these if a satisfactory adjustment is made of the first weights mentioned.

We have proceeded on the supposition that for the infantry soldier the kit which he must carry will be the present field kit, viz. :

1 cotton or flannel shirt.	1 brush.
1 pair trowsers.	1 holdall.
1 „ boots.	1 tin blacking.
1 „ socks.	1 forage cap.
1 towel.	

The total weight being $7\frac{1}{2}$ lbs. to 8 lbs. Also that carriage for ammunition equal in weight to about $5\frac{1}{2}$ lbs. must be provided. The remaining articles of the kit are carried in a squad bag during peace, and in time of war would be left behind.

We have given full consideration to every plan, and have made some practical trials which Colonel Wilbraham had the goodness to superintend at Netley. Of the various plans we have selected the following for additional trial.

A method of carrying the ammunition has been introduced into the Rifle Brigade which appears to be very successful. A pouch holding 50 or 60 rounds is carried by Lieutenant-Colonel Carter's belts, viz., by a central strap which, passing up the middle of the back, goes over the shoulders and below the armpits, divides into two straps, one running back to the pouch the other to the waistbelt. By an ingenious contrivance of Sir T. Troubridge the pouch opens at the side, as it cannot be opened at the top on account of the pack above it.

This plan is certainly open to the objection of bringing a large portion of the ammunition, and thus of concentrating weight, on one spot, but the ammunition is very much

* See Appendix iv.

† List of Reports laid before the Committee.—Report No. 1. Surgeon Wyatt's Pack; 2. Spiller and Berrington's Packs; 3. Spiller's Pack; 4. Colonel Carter's Pack; 5. Messrs. Silver & Co.'s Pack; 6. Report on Knapsacks and Accoutrements, by Medical Officers at Fort Pitt, Chatham; 7. Colonel O'Halloran's Pack; 8. Sir T. Troubridge's Valise; also Report on Trials of Sir T. Troubridge's Valise, Colonel Carter's, Prussian, Colonel O'Halloran's, and the Committee's Packs, made at Netley in 1865, and Report of Trials made at Netley in 1865 with Messrs. Silver's yoke.

more easily carried than by the crossbelt, and the chest is not at all compressed. If this pouch is worn, the kit can be carried above it in one or two ways, either by the plan devised by Sir T. Troubridge or by that of Colonel Carter.

Sir T. Troubridge's plan is to place the kit in a valise which lies on the loins and is supported by a yoke which rests on the tops of the shoulders, and is connected with the valise by two curved metal rods which pass in front of and beneath the arms, which however they do not touch.

The weight is thrown in the line of the centre of gravity and is more easily borne. The weight of the yoke and valise is $37\frac{3}{4}$ oz. or 2 lbs. $5\frac{3}{4}$ oz.

Lieutenant-Colonel Carter's plan is briefly as follows:—Two strong metal rods pass forward from the bottom of a framed pack, and are received into two leathern straps, which pass over the shoulders and fasten to the metal rods; the arms are quite free. The weight of the pack and rods is about 90 ounces.

Of course the risk of breakage is an argument against such metal contrivances, and we do not disguise from ourselves the gravity of the objection. But, as already said, the ease of these two plans is so great as to lead us to desire a practical trial of them, so that the exact amount of risk of breakage may be fixed.

We beg, therefore, to recommend that the new rifle pouch and Lieutenant-Colonel Carter's pouch shall be tried with Sir T. Troubridge's yoke and Lieutenant-Colonel Carter's pack respectively.

At the same time, we have been anxious to select some system in which no metal rods are used, and where there can be no risk of breakage and possibly of consequent injury, or, at any rate, of the soldier being suddenly deprived of the means of carrying his pack.

Of all the plans brought before us, that now in use in the Prussian army seemed the only system which appeared worthy of trial.

In this system a framed pack is cut to fit to the back, so that the weight is diffused over a large space; as the pack reaches low down, the ammunition is carried in front on a waistbelt, and two broad straps fixed to the top of the pack pass over the shoulders, and falling to the waistbelt, hook under it, and thus support the pouches. The pouches are then in part a counterbalance of the pack.

The two front pouches hold about 20 English rounds of ammunition each; the rest is carried in a partition at the top of the pack.

The pack is kept steady to the back by two straps running from the broad straps in front under the arms to the bottom of the pack. The weight of the pack is $89\frac{3}{4}$ ounces avoirdupois; the total weight of the pack straps, waistbelts, and pouches $130\frac{1}{4}$ ounces, or 8.1 lbs. avoirdupois.

The great coat is carried horseshoe fashion over the pack or over the shoulder; the canteen is carried on the back of the pack.

There are some great advantages in this plan; the weight is thrown over a large surface; the plan of balance and counterweight is brought into play; there is no injurious pressure; the pack is easily put on and off. It has now been used for four years in the Prussian army and has been well tested in the campaign with Denmark and is highly thought of.

There are, however, some disadvantages; the pack is too heavy; it seems absurd to weight a man with a box weighing $5\frac{1}{2}$ lbs. to enable him to carry a weight of $7\frac{1}{2}$ lbs. Too great a space in the pack is given to the ammunition, and it is a question whether this plan of placing some of the ammunition in the pack is a good one. There are occasions when soldiers ought to carry as large a supply of ammunition as possible, yet without other weight.

Again, there are no means of carrying the ammunition without the pack, except on the waistbelt alone; and there is no plan for carrying the great coat without the pack except in a roll over the shoulder.

Struck, however, with the advantages of the Prussian system, we have endeavoured to adopt some of its principles, and have tried to devise a plan of our own, which, though in many respects a borrowed one, is yet in some points original, and the results of numerous trials and alterations. We have endeavoured to perfect a plan which might meet the following requirements:—

1. The first requirement is that 60 rounds of ammunition should be carried alone. The best way of doing this is, we believe, not to concentrate the weight at one point, but to distribute it, and we have therefore made use of three pouches—the largest behind to carry 30 rounds, and two others in front to carry 15 rounds each. We have placed them on a Berrington hip-belt, so that, if necessary, they may be in part carried on the strong arch of the hip bones. To the centre of the back pouch a strap is buckled which passes

up the centre of the back, then divides and passes over the shoulders to the pouches in front. The weights before and behind thus balance each other, and the result is that 60 rounds are carried with extraordinary ease; the pouches are all made to fit close to the body, so that no part of the weight is thrown to a distance.

2. The next requirement is to carry the great coat and the ammunition, but without the pack.

By means of two additional straps, which are applied to other uses when the pack is carried, we have contrived a plan of carrying the great coat with the ammunition, so that in forced marches or night expeditions the men might take their great coats with one or two necessaries rolled inside, without the necessity of carrying the pack.

3. The third requirement is to carry the field kit at the same time that the ammunition, great coat, and canteen are carried. We have made a small light pack, cut to the back like the Prussian, which is so arranged as to be buckled to the same straps which carry the ammunition.

The great-coat straps are now applied for another purpose; they are buckled to the bottom of the pack, pass under the arms through a slit in the strap in front, and then over the shoulder to the top of the pack, so that the bottom of the pack is kept steady, and the top is brought close to the back near the centre of gravity. The plan must be seen to be understood, but it is very simple, and has several advantages. The arm pit is quite cleared, the bottom of the pack is steadied and raised, the top of the pack is brought close to the neck, so that there is no dragging back. The straps are reduced to a minimum, there is perfect freedom to the chest, there is no pressure anywhere, and the weights are universally diffused.

In front, where the cloak straps pass through the broad strap running down the front of the chest, a small iron plate, about 2 inches in length, is introduced to prevent the leather belt from twisting, but this is not in the way, and would not indeed be perceived.

The coat is carried on the top of the pack, and is covered with waterproof. The canteen is carried on the top of the great coat, so that all the weights are brought close to the body.

The haversack and water bottle can be carried on the waist belt in front.

The waist belt can be unbuckled at pleasure, and, if necessary, the coat opened in front when marching.

The pack is put on and taken off with the greatest ease, and without assistance.

This pack has been well tried at Netley, and has been found to be the easiest of any ever tried. The respiration is perfectly free, and no nerves or muscles are pressed upon.

The weight of the pack is 41 ounces, of the pouches and belts 48 ounces, making a total of 5 lbs. 9 ounces.

We believe this pack and the manner of carrying the ammunition to be a great improvement on the Prussian, but of course a more extended trial than we have given to it is necessary.

In fixing the dimensions of the pack, we have assumed that it is required to hold only the articles of the field kit as given on page 9.

In conclusion, we beg to make the following recommendations, and if your Lordship should see fit to authorize practical trials of the knapsacks and accoutrements we have selected, we shall be prepared to draw up a paper of instructions, and if necessary to undertake the general superintendence of the trials, and to make a final report when they have been made on a sufficient scale.

We beg to recommend that such a number of knapsacks and accoutrements of the four under-mentioned patterns be provided, and sent to such station or stations, as may be considered necessary to secure a fair trial, proper instructions being forwarded, so that the trials may be conducted on some uniform and comparable plan.

1. Sir Thomas Troubridge's yoke, valise, and accoutrements.

2. Lt.-Colonel Carter's knapsack and accoutrements, the latest improvements being introduced.

3. The Prussian pack and accoutrements.

4. The pack and accoutrements devised by the Committee.

With regard to the procuring of these patterns for trial, the Committee suggest that authority be given to Sir Thomas Troubridge and Lt.-Colonel Carter to provide their own patterns. The Committee will undertake to provide the requisite number of patterns of their own and the Prussian pack on receiving authority to do so.

When these various patterns are ready, we would suggest that they be inspected by the Committee for the purpose of seeing that they conform to the patterns chosen by them.

With respect to the Field Companion carried by the sergeants of the Army Hospital Corps, we have requested Professor Longmore to make some experiments in this point, and when they are completed we will make a special report on the subject. Professor Longmore will, however, defer his experiments until some definite conclusion has been come to in respect of the Infantry accoutrements and pack.

HENRY EYRE, Major-General.

R. RUMLEY, Major-General.

A. H. HORSFORD, Deputy Adjutant-General.

T. G. LOGAN, Inspector General of Hospitals.

E. A. PARKES, Professor of Hygiene.

J. J. FREDERICK, Secretary,
War Office, July 28th, 1865.

APPENDIX.

No. 1.

STATISTICAL TABLE in regard to HEART DISEASE in the ARMY.

Year.	Ages.	Strength.	Died of Heart Disease.	Dis- charged for Heart Disease.	Deaths from all causes.	Dis- charged as Invalids from all causes.	Ratio per 1,000 Strength.				Proportion of Heart Disease to	
							Died of Heart Disease.	Discharged for Heart Disease.	Deaths from all causes.	Discharged as Invalids from all causes.	Total Deaths.	Total discharged as Invalids.
1861 -	Under 20 -	5,363	—	15	14	87	—	2·79	2·61	16·22	—	1 in 6
	20 to 24 -	10,456	2	48	71	366	·19	4·59	6·79	35·00	1 in 35	1 in 8
	25 and upwards	10,900	16	63	120	482	1·47	5·78	11·01	44·22	1 in 7	1 in 8
1862 -	Under 20 -	4,427	—	11	6	41	—	2·48	2·03	9·26	—	1 in 4
	20 to 24 -	12,420	1	49	69	289	·08	3·95	5·56	23·27	1 in 69	1 in 6
	25 and upwards	12,592	18	59	119	427	1·44	4·72	9·52	34·15	1 in 7	1 in 7
1863 -	Under 20 -	3,004	—	2	3	25	—	·67	1·00	13·19	—	1 in 12
	20 to 24 -	10,200	1	54	47	319	·98	5·29	4·61	31·20	1 in 47	1 in 6
	25 and upwards	11,792	21	55	138	481	1·79	4·66	11·70	40·79	1 in 7	1 in 9
Average, 1861-3.	Under 20 -	—	—	—	—	—	—	2·19	2·03	11·93	—	1 in 6
	20 to 24 -	—	—	—	—	—	·12	4·57	5·65	29·45	1 in 7	1 in 6
	25 and upwards	—	—	—	—	—	1·56	5·02	10·66	39·40	1 in 7	1 in 8

No. 2.

THE INFLUENCE of the present KNAPSACK AND ACCOUTREMENTS ON THE HEALTH OF THE INFANTRY SOLDIER.—By W. C. MACLEAN, Esq., M.D., Deputy Inspector-General, Professor of Military Medicine, Army Medical School, Netley. (From the Journal of the Royal United Service Institution vol. viii.)

MR. CHAIRMAN AND GENTLEMEN,

I purpose this evening to call your attention to the influence of the present knapsack and accoutrements on the health of the infantry soldier.

Whatever may have been the case in times past, it is certain that everything bearing on the health and happiness, the moral and physical well-being of the soldier, is now a subject of anxious consideration to the authorities, and of interest to the community at large.

After much careful inquiry into barrack and hospital accommodation, including the important subjects of ventilation, drainage, and surface space, very considerable improvements have been carried out, with the results of diminishing sickness and mortality in a very remarkable manner. Increased attention to clothing, food, moral and intellectual training, and wholesome recreation, has gone hand in hand with the other improvements, and materially contributed to the end in view.

Among the improvements just mentioned, few were more imperatively called for than those affecting clothing. If time and the occasion admitted, it would not be a difficult task to show that for a long period of time the inventive genius and good sense of this country were not seen to much advantage in military costume. The “follies of the wise” have often been conspicuous in the clothing and equipment of our soldiers. The generation familiar with heads labori-

ously soaped, powdered, plastered, and pigtail-tied, has only just passed away. The satirist who sang—

“ God bless the Guards, tho’ worsted Gallia scoff;
God bless their pigtails, tho’ they’re now cut off,”

has not long disappeared from the clubs of London.

It is only within the last few years that any difference worth naming was to be seen in the dress of the British soldier in Calcutta and one quartered at Chatham.* A very few years ago I saw a batch of unhappy recruits learning their drill at Arcot, the hottest station in the hot Carnatic, buttoned up in red jackets, lined with stout serge, that had been served out to protect them from the cold of the English Channel.

The great bulk of the British army embarked for service in the Crimea clothed in tight fitting coats, the skirts of which had been pared away until nothing remained but a ridiculous appendage, fondly imagined by tailors to resemble the tail of a swallow. We still see these garments in Monmouth Street, and on the persons of deputy-lieutenants of counties on occasions of state. In the museum at Netley we have a collection of military head-dresses most wonderful to look at. Yet they were very dear to their contrivers, and—in another sense—to those who had to carry

* Professor Longmore assures me that the tunics and trowsers issued to his old regiment in Bengal, during the mutiny, were heavier than those worn in Canada.—W.C.M.

them on their heads in all climates, from Canada to Cawnpore. Most of them, I have no doubt, are familiar to many gallant officers present; they are old acquaintances of my own, for I may truly say I have seen nearly all of them "dance into light, and die into the shade." We preserve them for the wonder if not for the admiration of generations to come. Then we had the leather stock. We all remember it well; how long it stood its ground, how hard it was to get rid of; and I have no doubt that, like myself, some of my audience are acquainted with a few elderly friends who cherish the memory of that garotting apparatus to this day.

Forgive this retrospect at past errors; trivial, ludicrous even as some of them now appear, they were each in their time and degree causes of suffering, sickness, and premature death.

If we have made mistakes let us not be ashamed to own them, and let careful study teach us to avoid them for the future. On my appointment, three years ago, to the chair of military medicine in the Army Medical School, I was placed in a position where I could study on a large scale the chief causes which influence the health of the army. As at Fort Pitt formerly, so now at Netley, the invalids from all parts of the world may be said to pass in review before the medical officers of that great establishment, who have thus an opportunity of examining men who have served in almost every region of the globe, and observing on their persons the effects of service in various climates, and the influences hostile to health to which they have been exposed; and while it is the chief duty of the Professors of the School of Military Medicine to teach the young medical officers the many valuable lessons derived from such an immense field of observation, it is no less their duty from time to time to give to the authorities such information as may lead to improvements calculated to promote the health and happiness of the soldier, to diminish suffering and mortality, to lessen cost, and promote efficiency. It is because I conscientiously believe that the subject to which I am about to call your attention this evening has important bearings in all these directions that I have determined to lay it before the members of this admirable institution, convinced that nowhere could I find an audience more capable of understanding the great practical importance of the inquiry, or more interested in its right solution.

I had not been long in the position I have the honour to fill in the public service before I became profoundly impressed with the vast losses sustained by the prevalence in the army of consumption and diseases of the circulatory system, that is, of the heart and great vessels. Within the last three years, excluding those who die in regimental and dépôt hospitals, and those of the Household troops (I exclude all invalided in Ireland, of whom we at Netley see nothing), no less than 1,344 men have been lost to the service from consumption alone. Now the causes in operation tending to produce this enormous and costly loss are many and complicated.* That the

* A very general impression prevails that the recommendations of the Royal Sanitary Commissioners as regards the amount of cubic and superficial feet per man in barracks has been universally carried out. This, however, is far from being the case. The home regulation is 600 cubic and about 60 superficial feet per man, but even this *minimum* is rarely enjoyed by the soldier.

In Chatham the average cubic space is only 450. In hot Gibraltar the Barrack Commissioners report that no fewer than 3,617 men have under 450 cubic feet each, and 5,253 have less than 40 square feet each. While such a state of things exists, we cannot be said to have taken a single step to mitigate, much less remove, what is certainly the master sin of our whole system, viz., overcrowding in barracks.

According to General Morin, the reporter of the commission ordered to determine the ventilation of the Palais de Justice and the new theatres of Paris, as quoted by Dr. Parkes, to keep the air pure there must be supplied—

In barracks, by day, 1,060 cubic feet per head per hour.

 " by night, 2,120 " " "

—W.C.M.

present accoutrements and knapsack, interfering as they do with the free play of the important organs within the chest, exert an important influence in this direction I do not doubt; but as the proof of this would lead me into details, and involve many points of inquiry not suited for discussion here, I shall not go further into it on this occasion, but will direct your attention to another source of inefficiency which can be more directly traced to the *mischievous constriction* to which we subject the chests of our soldiers at the time we demand from them the *maximum of exertion*.

Between the 1st of July 1860 and the 30th of June 1861, 2,769 men were discharged the service at Fort Pitt. Of these, 445 (or 16·07 per cent.) were under two years' service; and of these 445 discharges *heart diseases* made up 13·7 per cent. From the 1st July 1861, to 30th June 1862, 4,087 men were discharged the service; 569 of them (or 13·92 per cent.) had less than two years' service, and of these 14·76 per cent. were lost to the service from *heart diseases*.

From the date of my assuming charge of the medical division at Fort Pitt, in April 1861, to the end of last year, no less than 883 cases of diseases of the circulatory system—in other words a number nearly equal to the strength of a battalion—have passed under my observation, and been lost to the service, and this from one class of disease; the great bulk of the cases being young men returned to the civil population (that is, cast upon their parishes), and incapable of earning their bread in any active employment. The pension allowed to such short service men is but a pittance, and that pittance is granted only for a limited period. Let me remind you again that in the figures I have given the invalids of the Royal Artillery, the Guards, and the troops serving in Ireland are not included; they were discharged without being seen by us at all.

Surely, gentlemen, you will agree with me, after hearing a statement so startling, that it behoves us to look narrowly into a question involving such an amount of suffering, costly invaliding, and inefficiency, with a view to the adoption of a remedial measure.

Before I address myself to an examination of the accoutrements and knapsack, and show the evils they induce, I must advert for a moment to three causes which are supposed to exercise a disturbing influence on the organs of circulation, and to act either as predisposing or exciting causes of disease of the heart, viz., rheumatism, intemperance, and excessive smoking.

Rheumatism affects the fibrous structures of the frame; these structures enter into the formation of the delicate valves of the heart, and these valves are apt to suffer from this disease, to have their mechanism injured, and so to interfere prejudicially with the working of the heart, the central moving power. Now, many cases of heart disease can be traced to this cause; and soldiers, from the very nature of their calling, are of course much exposed to rheumatism; but, making a fair allowance for this, particularly among old soldiers, an immense number of cases remain that cannot be accounted for in this way. A vast number of the young soldiers discharged the service for heart disease have never suffered from rheumatism at all.

With regard to intemperance, it is undeniable that the presence of alcohol in the blood exercises a prejudicial influence on the heart and great vessels, as well as on other organs, but here we have the same difficulty to meet, viz., that a large proportion of our young lads are lost to the service from heart disease ere they have contracted the baneful habit of spirit drinking.

Nor do I deny that excessive abuse of tobacco may in many cases result in an irritable condition of the heart, incapacitating a man from much exertion; but I think there is no proof that young soldiers smoke more than other classes of the population.

Is it that soldiers are called upon to make greater

exertions than the labouring and manufacturing classes? Doubtless the soldier has at drills, marches, and field-days to put forth considerable exertion; but is this more than, or so much, as we see daily done by our "navvies," and others of the labouring classes? I think not. We must look, then, to the different conditions under which the two classes work. A labouring man or mechanic, when he addresses himself to his work, lays aside every weight, and every article of dress that can in the slightest degree interfere with the free movement of his chest and limbs. In like manner, the sportsman, or the Alpine tourist, adapts his dress to the work in which he is engaged. But the soldier, on the other hand, is called on to make the severest exertions, at the utmost possible disadvantage as regards the weight he has to carry, the mode in which he has to carry it, and the entire arrangement of his dress and equipment.

The function of respiration in health, when we are not unduly exerting ourselves, is carried on with so much ease and regularity, that we are hardly conscious of the action of its complicated mechanism; we draw air into our lungs and expel it without an effort. It is only when we experience in our own persons, or witness in others, the effects of even a momentary interruption to the due performance of this function, that we become aware of its vital importance to our very existence. Three minutes' total suspension of respiration, and we die. So essential is respiration to existence, that it is placed under the control and guidance of a part of the nervous system apart from the will, and it is only when the function is interfered with by disease or excessive exertion, that the assistance of muscles, under the direct control of that will, is called in to aid us in the struggle for the free admission of that air, without which we die. Let us glance for a moment at the chest and its contents.

I have here the framework of the torso or trunk. Within the elastic walls of the chest are placed the lungs, the heart, and the great vessels leading from it, and these fill it equally in all its alterations of size; it is so contrived as to shield these vital parts from injury (save of course from injury of an extreme degree), and yet to give them that free play without which their functions cannot be performed. You observe its construction—consisting of the spinal column behind, itself made up of many separate pieces, with an elastic fibro-cartilaginous cushion interposed between its separate parts, represented artificially here, the breast-bone in front, and the ribs or osseous arches enclosing the chest. Note that each rib has a cartilage of prolongation; these are of great strength, and very elastic. By their means the seven true ribs are connected directly to the breast-bone, those of the remaining ribs merely to each other. You cannot fail to observe that there is here unequivocal evidence of a provision for motion. Let us look now at the movements to which this anatomical arrangement points.

During inspiration the collar bones, first ribs, and through them the breast-bone and all the annexed ribs are raised; the upper ribs converge, the lower diverge, the upper cartilages form a right angle with the breast-bone, and the lower cartilages of opposite sides from the seventh downwards move further asunder, so as to widen the abdominal space between them just below the point of the breast-bone; the effect being to raise, widen, and deepen the whole chest, to shorten the neck, and apparently to lengthen the abdomen. During expiration the position of the ribs and cartilages is reversed; the breast-bone and ribs descend, the upper ribs diverge, the lower converge; the upper cartilages form a more obtuse angle with the breast-bone, and the lower cartilages of opposite sides approximate, so as to narrow the abdominal space between them just below the point of the breast-bone; the effect being to lower, narrow, and flatten the whole chest, to lengthen the neck, and

apparently to shorten the abdomen. During inspiration the movement of the lungs and heart is downwards.*

Let us now inquire whether there is anything in the mode in which the soldier is weighted and accoutred likely to interfere with these natural movements more or less at all times, and particularly when making severe exertions. And here I must take the opportunity of saying that this question has been very carefully examined by the professors of the Army Medical School; and, after mature consideration and inquiry into the whole question, we have arrived at the conclusion that the present accoutrements are highly injurious to the health of infantry soldiers, and have a large share in producing many affections of the lungs and heart common among them; in fact, so impressed have we been with the importance of the subject, that, in conjunction with Major Deshon, 2nd Depot Battalion, an officer who has paid a great deal of attention to these points, we made two reports on the pack and accoutrements of the infantry soldier, which reports were presented to the General commanding at Chatham. From these reports I shall quote largely in the course of the following observations. It will perhaps be well for me to mention that two great military nations, France and Prussia, have experienced the inconvenience of a faulty system of accoutrements to such an extent that they have introduced improvements intended to relieve the soldier from injurious pressure upon his chest and abdomen, and to interfere as little as possible with the free action of his muscles and organs.

The weight of the British soldier's clothes, great coat, field kit, and canteen, with 60 rounds of ammunition and 75 caps, havresack, bayonet, rifle, and sling, pack and straps, pouch, &c., &c., is 48 lbs. $5\frac{1}{4}$ oz.

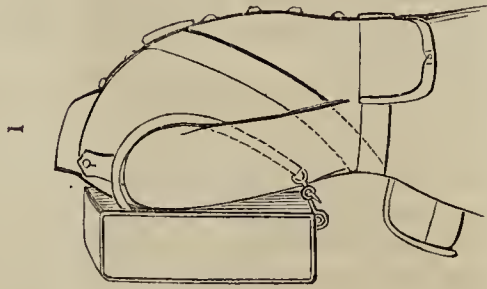
If the soldier has to carry his blanket, as in the field, with rations for three days, and his water-bottle, an addition of 12 lbs. is made, making in all 60 lbs. $5\frac{1}{4}$ oz.

Let us now look a little closer at the regulation pack. In the diagram before you (page 16, Fig. 1) is a drawing of it. You cannot fail to see that the whole weight of the pack is thrown on the straps passing under the arms; the pouch and a small packet for caps are carried on the belt, which runs diagonally across the chest, and the bayonet and ball-bag are carried on the waist-belt; the belts are therefore so disposed as to press most injuriously on the chest; the cross-belt, stretched by the great weight of the pouch, impedes the forward movement of the ribs; the waist-belt hinders the expansion of the inferior false ribs, which, as we have just seen, in the state of unrestricted movement, is very great; and the pack-straps press on important muscles, arteries, veins, and nerves to a degree which only those who have carried the loaded pack can appreciate. The weight, especially when the great coat is strapped on, falls to a great extent behind the line of the centre of gravity. Now these objections are by no means merely theoretical; soldiers universally complain of the sufferings they endure from the pack and present accoutrements, and if you closely question the sufferers from heart disease, you will find how closely they connect their complaints with these belts and packs.†

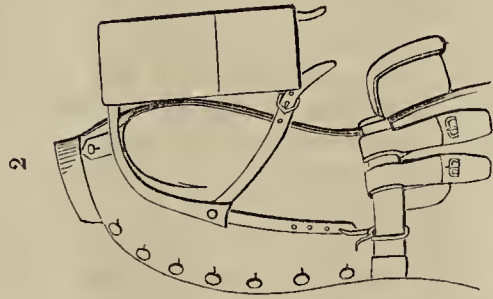
It is certain that at no period was the pack more worn than at present. I find that it is worn at least once

* Vide Sibson's Medical Anatomy.—Here Dr. Maclean showed a figure in outline, displaying the extent of these movements, and also a skeleton of a trunk, showing its framework, &c.—ED.

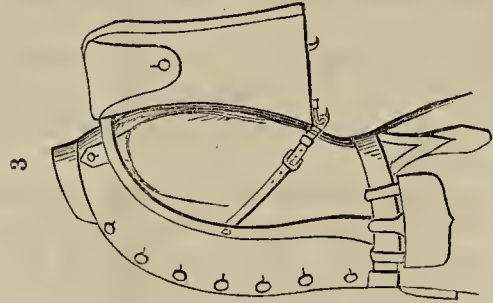
† Here the Professor showed a preparation of a human heart, taken from the body of a soldier, with a white spot or corn on it, which he explained arose from the pressure and friction to which the organ had been exposed. He further stated that this "corn," rare in civil life, is the rule and not the exception in the bodies of elderly soldiers.—ED.



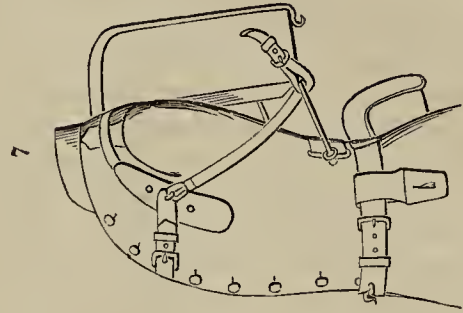
British Regulation.



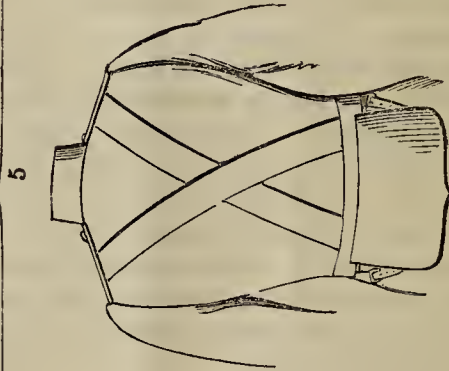
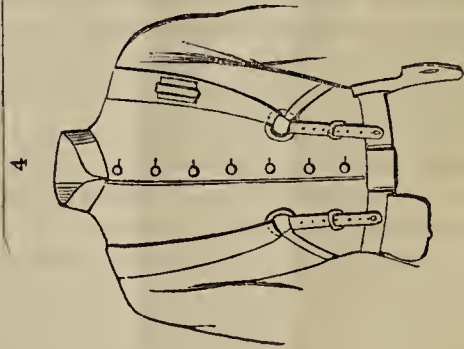
French.



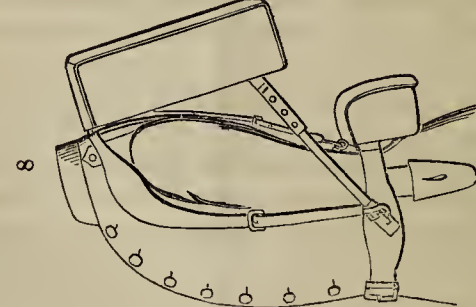
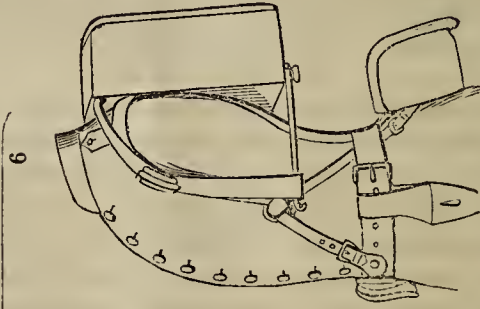
Prussian.



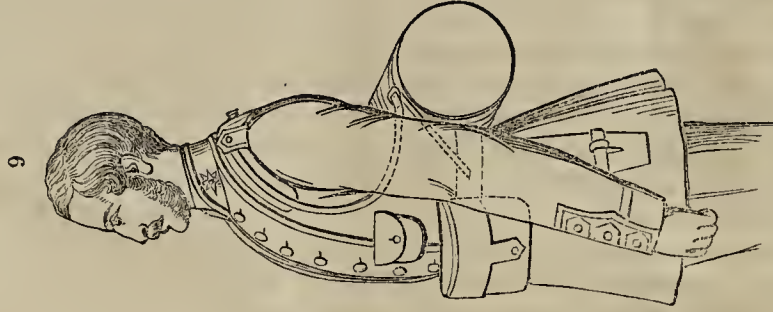
Col. O'Halloran's.



Lieut.-Col. Carter's.



Dr. Parkes'.



Sir Thos. Troubridge's.

a day on regimental parade, and on all brigade and field days at all the camps in this kingdom. I have been at some pains to ascertain from regimental medical officers the effects observed on the men, particularly on field days. Some do not appear to have paid much attention to the subject, but the majority seem alive to the ill effects of the pack and accoutrements.

Many men fall out in a state of extreme distress, and many surgeons assure me that nothing but a strong feeling of *esprit de corps* prevents many more from doing so. In all well-disciplined regiments the practice of falling out at drill or on the line of march is discouraged, and men will bear and suffer much, rather than incur the imputation of being "soft"—some, to my own knowledge, have worked on through a field day, and have died rather than give in. An instance of this occurred at Aldershot on a field-day last summer.

In the first of the reports on packs submitted for the consideration of the General commanding at Chatham, by the professors of the Army Medical School, the following were the general principles insisted on:—

1. To distribute the weight, as far as practicable, over the body.
2. To bring the weight, as far as possible, within the line of the centre of gravity.
3. To allow no pressure on the principal muscles, nerves, arteries, or veins.
4. To avoid most carefully all impediment to the fullest expansion of the lungs, and to the action of the heart.

This rule is a cardinal one. Unless the circulation through the lungs be quite free, continued exertion becomes impossible. The commonest experience shews that the number of respirations, and the amount of air drawn into and expelled from the lungs, is enormously increased by exertion. Late physiological inquiries have shown that the elimination of carbonic acid is also prodigiously augmented, and this is a necessary sequence of the muscular contraction. If this elimination be prevented by any interference with respiration, no amount of energy or volition on the part of the man will enable him to continue his exertion. Trainers, both of men and horses, have long been aware of this fact.

I have just shown you how impossible it is to carry out such principles as these with the regulation pack, which is constructed as if for the purpose of transgressing them all.

Fig. 2 shows the French pack, that worn by the Chasseurs de la Garde. It is secured by straps going under the arms, as in the English pack; but it is an improvement on the latter, as two straps run down from the arm-straps to the waist-belt, and so relieve in great measure that excessive pressure on the arm so much felt by our men. It approaches the Prussian pack, but is not so good; the pouch (which is small) is carried on the waist-belt behind, and there is no cross-belt whatever; the lungs have therefore very fair play with this pack, the amount of ammunition is, however, smaller.

Fig. 3 shows the Prussian pack and accoutrements. You see that they are arranged differently from any of the others. The ammunition is carried in two pouches attached to the waist-belt, capable of carrying each 20 rounds of English ammunition, and 15 of Prussian. The pack fits to the back, to which it lies as close as possible. Two broad straps pass from the top of the back over the shoulders and fall to the waist-belt, to which they are joined by two brass hooks.

Two other straps run from the lower part of the pack and join these shoulder-straps, so that the pack is quite steady, and its weight is counterbalanced by the pouches in front.

This pack is much superior to ours; it exerts only moderate pressure on the lungs, and none on any muscles or vessels; the weights are close to the

body, and the weight of the pack falls within the centre of gravity. The arms have full play. In the trials conducted by us, this pack was invariably preferred by the men to our own, although it was not rated so highly as others.

Figs. 4 and 5, show front and back views of Lieutenant-Colonel Carter's accoutrements. Fig. 6, side view of accoutrements and pack. The pack is supported by two straps passing over the shoulders and hooking on to two iron rods, which project forward from the lower end of the pack; the front of the pack is concave, and is made of wicker work; its weight is very great, and it is altogether too large.

It is, however, a vast improvement on the regulation pack. It is borne on the shoulders, and does not press at all on the lungs, or upon any muscles, nerves, or vessels; the arms are quite free. The pouch, which is a large one, hangs away from the body too much. It is, however, carried easily. The belts are too heavy and complicated. In our trials the men reported favourably on this pack, all who tried it declaring it to be an immense improvement on the regulation pack.

The next is Berrington's pack, adapted with Colonel Spiller's rods by Colonel O'Halloran (Fig. 7). The belt represented in this drawing as passing across the chest is done away with in Colonel O'Halloran's improvement pack.

It is carried by means of two flexible steel plates lying in front of the chest, and having attached to them two straps passing from the lower end of the pack beneath the arms. Two rods, with a broad strap between them, support the lower part of the pack against the small of the back; no muscles or vessels are pressed upon, and the arms are perfectly free. The weights are tolerably close to the centre of gravity. With this pack, the pouch and bayonet are carried as in the regulation pack. The steel plates were thought by us an objection to this pack, as by their breadth they, in some degree, press on the ribs in inspiration. The pack, however, in our trials was favourably reported on.

A pack contrived by my colleague, Dr. Parkes (Fig. 8.), was also tried. The principle of it is to throw the weight in part on the hips, by means of two straight iron rods running from the bottom of the pack, and fitting into two sockets in a hip-belt. The principle of this pack is sound, but there is a great objection in this, as in the others, to the iron rods, which, if broken on service, cannot easily be replaced. They are also dangerous, for if struck in action the fragments would almost certainly be driven into the body of the wearer, or that of a comrade in the ranks. The conclusion come to by us, after a careful examination of all these packs, and carefully conducted trials with them all, was, that the regulation mode of carrying the pack was the worst of all; but good as some of the proposed plans are, none of them seem perfectly to answer all the required conditions.

Lieutenant-Colonel Carter and Colonel O'Halloran were not the only officers who saw the necessity of introducing a new and a better mode of carrying the pack.

Sir Thomas Troubridge exhibited at the last Great Exhibition a valise, which I now show you (Fig. 9), and on which we (the professors) made a special report to Major-General Eyre, Commanding at Chatham, an officer who has taken a great interest in this question, and who gave us his cordial co-operation in investigating it.

This pack is carried in a mode different from any of the others. A yoke, on the principle of the milkmaid's yoke, is fixed on the shoulders; from this two metal rods of tubular copper or of steel pass down in front of the arm-pits, which they do not touch, and are hooked behind to a round bag or valise (without any frame), which is carried on the small of the back, or just above the hips. The weight of this valise is chiefly thrown on the shoulders, but it is also partly thrown on the strong hip-bones, in this resembling

Dr. Parkes'. There is not the least pressure, either on the chest or on the arm-pits.

As the valise is thus carried so low down, the ammunition cannot be carried in a pouch behind. It is, therefore, placed in two pouches in front (each intended to carry 30 rounds), and a strap passes round the back of the neck, and hooks into each pouch.

A waist-belt carries the bayonet, and keeps the two pouches steady; the pouches thus balance one another, instead of, as in the Prussian plan, the pouches balancing the pack.

The great-coat can be carried either on the top of the valise, or in a roll over the shoulder.

On considering the mode in which the weights are distributed on this plan, it is evident that it satisfies all the conditions which we formerly enumerated as essential to a perfect system.

Not the slightest pressure is made on the lungs; no great muscle, vessel, or nerve, is pressed upon; the weights are close to the centre of gravity, and are as near the line of the centre of gravity as they can be; while the strongest parts of the body, viz., the tops of the shoulders and the hip-bones carry the weights.

As far as mechanical and physiological principles are concerned, we see nothing wanting in this plan. The weight, in pounds and ounces avoirdupois, of Sir Thomas Troubridge's valise, with kit, ammunition, &c., is 17 lbs. 12 $\frac{2}{3}$ oz.

Any one who has seen the enormous weights carried by the Canton water-bearers, or the Banghy Burdars and palankeen-bearers of India, all borne on the shoulder, in such a way as not to interfere with the free play of the chest, will see that Sir Thomas Troubridge has thus hit on the right principle for carrying the soldier's pack and ammunition. We submitted this plan to a trial against O'Halloran's pack, as improved and exhibited in the last Great Exhibition.

Four experienced non-commissioned officers, and privates, after being carefully examined by me to see that they were free from chest disease, were marched eleven or twelve miles accompanied by Major Deshon, who closely watched them: they used the pack and valise alternately, and on returning, their unprompted statements were taken down by me verbatim. Without going into details, I may say that the reports of

all the four men were identical: they all praised Colonel O'Halloran's pack, and thought it much better than the regulation, but they reported of the valise that it was as superior to Colonel O'Halloran's pack, as that was superior to the regulation.

The ease of breathing, the freedom of the arms, the apparent lightness of the weights, the absence of fatigue or exhaustion at the end of the march, with Sir T. Troubridge's accoutrements, were all points strongly insisted upon by these experienced non-commissioned officers and soldiers; nor did they hesitate to affirm that the efficiency of the soldier would be increased to an immense extent by their adoption throughout the service.

In conclusion, I trust that some of the distinguished officers present may be induced to inquire into this subject for themselves, to make comparative trials with the packs just exhibited, and with the contrivance of Sir Thomas Troubridge; if any can be induced to do so, and to investigate it thoroughly, I feel convinced they will find that my colleagues, and the gallant officers who have co-operated with us, have not exaggerated its importance. I am quite aware that the introduction of a new knapsack into the service would be a very costly measure; but if once the fact is established that the present knapsack is costly from the amount of invaliding it entails, and cruel from the suffering it causes, enough will be done to warrant, at least, the gradual introduction of a better. To an audience such as this, I need hardly add, that the tendency of modern tactics, all over the world, is to rapid movements in the field, and if it is insisted on, that modern soldiers shall march and fight with their kit on their backs, it is obvious that this should be so placed, as to embarrass their movements to the smallest extent, if not they must fight and march at a grievous disadvantage.

The Chairman: I am sure Dr. Maclean will be ready to answer any question that any gentleman may wish to put, or should any gentleman wish to illustrate the subject by mentioning the results of his own experience, we shall be very glad to hear him. If no one has any observations to make, I am sure you will now join me in a vote of thanks to Dr. Maclean for the interesting lecture we have had, and for the able manner in which he has delivered it.

No. 3.

DAILY DRILL SEASON from November to April inclusive.

Depôt Battalion.	Station.	Hours.	Distribution.	Period with Packs.
1	Chatham - -	3 20	8 30 to 9 30 10 30 " 11 50 2 " 3	Only after marching order parade.
2	Ditto - -	3 on 3 days 2 30 1 day 2 1 day 1 1 day	8 30 " 9 30 11 " 12 2 " 3	$\frac{1}{2}$ hour on Thursdays. Those sufficiently advanced to take duty in the ranks for drill with the battalion from 1 hour to 1 $\frac{1}{2}$ hours. Recruits drilling in rifle drill (which takes place in 7 weeks) drill throughout the course (3 weeks) in their packs.
3	Ditto - -	3 on 5 days	8 " 9 10 30 " 11 30 2 30 " 3 30	At rifle drill (2.45 for 6 days per week) the pack is worn. Those not at rifle wear their packs from 10 to 10.30 a.m. for the first 5 days of the week, i.e. 2 $\frac{1}{2}$ hours per week.
4	Colchester - -	3 (Actual drill)	8 45 " 9 45 10 45 " 12 15 2 " 3 15 (The excess over the 3 hours is taken up in marching.)	Twice a week (Tuesdays and Thursdays), at $\frac{1}{4}$ to 11, the recruits parade with packs, but after inspection take them off, except the 1st squad. During the last week at drill the pack is worn at all drills. During rifle drill worn.
5	Parkhurst - -	3	8 30 to 9 30 11 " 12 2 " 3	Packs inspected on Wednesdays; taken off for drill. At rifle drill (commenced at 6 weeks or 2 months) they wear packs. 1st squad after rifle drill are drilled in packs from 11 to 12. If a recruit is approved, if under age or slight, he wears no pack for 4 or 6 months, even at rifle drill.
6	Walmer - -	3	8 30 " 9 30 11 " 12 2 15 " 3 15	Drill with packs for the last 2 or 3 days before being dismissed to drill. Wear their packs during musketry drill.
7	Winchester - -	3	8 45 " 9 45 11 " 12 2 " 3	Only at musketry for 1.30 hours daily.
8	Pembroko - -	3 15	8 30 " 9 30 10 30 " 11 45 2 " 3	1st and 2nd class wear packs without great coats from 2 to 3 p.m.
9	Colchester - -	2 45	8 30 " 9 15 10 15 " 11 15 2 " 3	Never with packs.

No. 2.—DAILY DRILL SEASON—*continued.*

Depôt Battalion.	Station.	Hours.	Distribution.	Period with Packs.
10	Colchester -	3	8 45 to 9 45 11 " 12 2 " 3	Packs worn for 1 hour each day for about 3 weeks before being dismissed to drill.
11	Preston - -	4	8 30 " 9 30 10 30 " 12 2 " 3 30	With packs from 10.30 to 12; the first half occupied with inspection.
12	Athlone - -	3 15	8 15 " 9 15 10 30 " 11 30 2 " 3 15	All wear packs at the 2nd drill. About one-fifth preparing for musketry drill wear packs at the 3rd drill.
13	Birr - - -	2 45	8 30 " 9 15 11 " 12 2 " 3	1st squad wear packs for 1 hour on Wednesdays and Fridays. At rifle drill wear packs.
14	Belfast - -	3	9 " 10 11 " 12 2 " 3	Wednesdays and Fridays from 11 to 12 with packs.
15	Buttevant -	3	8 20 " 9 20 10 30 " 11 30 2 " 3	Packs on Wednesday and Friday from 10.30 to 11.30.
16	Templemore -	2 15	10 15 " 11 30 2 " 3	During the last month wear packs once a day from 2 to 3. During the last fortnight wear packs at both drills.
17	Limerick - -	3 20	9 " 9 45 10 30 " 11 30 2 " 2 30	Mondays and Thursdays parade with packs, but do not drill in them.
18	Fermoy - -	2 45	8 30 " 9 15 10 30 " 11 30 2 " 3	1st squad wear packs at 10.30 to 11.30 for 10 or 14 days before going to musketry.
20	Cork - - -	3	8 30 " 9 30 10 30 " 11 30 2 " 3	One hour on Monday and Wednesday. Before they go to musketry they wear their packs continually.
22	Stirling - -	3	8 30 " 9 30 11 " 12 2 " 3	No packs.
23	Aberdeen - -	3 45 (but about 35 minutes occupied in marching to drill ground.)	6 30 " 7 30 10 15 " 12 30 2 " 3 30	One drill daily for about 3 weeks before going to musketry.

No. 4.

ENUMERATION OF THE VARIOUS PLANS OF CARRYING THE KIT AND AMMUNITION SUBMITTED TO THE COMMITTEE.

MILITARY PACKS.

1. *British Regulation.*—Ammunition carried by cross-belt; pack carried by straps passing under arms.

Objection.—Chest compressed by cross-belt; pack straps cut the armpits; cause swelling and numbness of the hands; weights badly distributed, so that there is great discomfort and unnecessary fatigue.

2. Do. with altered arm straps of pack.

Objection.—As above, the alteration of the straps failed.

3. *Pattern proposed by Colonel Daubeny.*—The British regulation with waterproof cover for the great coat; all the straps are sown on, so that there is no fear of loss.

Objection.—As above.

4. *French Regulation* (pattern of 1860).—Ammunition carried on waist-belt behind; pack carried by straps passing under arms, but relieved by additional straps passing to waist-belt.

Objection.—Ammunition too small in quantity; waist-belt drags up or is made very tight; too much weight thrown still on the armpits.

The plan is, however, a great improvement on the British.

5. *Italian Regulation.*—Identical in principle with the French.

6. *Prussian Regulation.*—Ammunition carried partly *in front*, in two pouches; partly in the knapsack; the pouches are carried on the waist-belt. Pack cut to and supported on the back, and in part carried by straps passing over the shoulders to waist-belt and hooking under the pouches.

Advantages.—Great ease; no pressure on chest; weights tolerably well distributed; pack easily put on and taken off.

Objections.—Pack too heavy; reaches too high, so that the canteen must be carried on the

back of the pack. The carrying of ammunition in the pack objectionable.

Recommended for trial.

7. *Danish Regulation.*—Mode of carrying is in principle the same as the French.

8. *American (Federal) Regulation.*—This is a bag which opens in the centre, something like a saddle bag. It is carried by straps passing over the shoulders and under the arms, as in the British regulation, and is liable to the same objection.

In addition to the above all the accoutrements and knapsacks in the Royal United Service Museum were inspected, but it is not considered necessary to enumerate these; they are all similar in principle either to the French or Prussian.

PLANS PROPOSED BY INVENTORS.

9. *Lieut.-Colonel Carter's Accoutrements, Pouch and Pack.*—Described in Report. Recommended for trial.

10. *Sir Thomas Troubridge's Yoke and Valise.*—Described in Report. Recommended for trial.

11. *Accoutrements and Pack devised by the Committee.*—Described in Report. Recommended for trial.

12. *Colonel O'Halloran's Pack.* (Berrington's Pack, with Colonel Spiller's rods).—A framed pack with leathern straps passing from the top of the pack over the shoulders, and ending in two steel plates which lie on the chest. At the bottom of the pack are two short curved rods, between which stretches a broad band which lies upon the small of the back.

Advantages.—The weight is well distributed on the shoulders and back, and slightly on the chest. The pack is away from the back, and there is good ventilation.

Objections.—The steel plates in part press on the ribs and restrict their movements after the pack has been worn for some time and the muscles

are tired. The rods behind might break and injure the bearer, and are objectionable.

On practical trial it has been found that, although very comfortable, and a great improvement over the regulation pattern, it is not so easy as the packs selected by the Committee.

13. *Mr. Brady's Pack*.—A framed pack, rather larger above; in front, at the lower part, is a small bag, which can hold two or three articles, such as a shirt and pair of socks, which can thus be got at without the pack being opened. The projection thus caused rests on the back.

Carried like the British regulation, or like the Prussian.

As the peculiarity consists merely in the shape of the pack, and as the proposed advantages of this shape did not appear of importance to the Committee, it was not considered necessary to try this pack further. If carried like the British regulation it is open to the same objection; if carried like the Prussian, it has no advantage over this, but is indeed inferior in shape.

14. *Captain Goold's Plan*.—A framed regulation pack, with curved metal springs fixed to the top and hooking on to the shoulders and front of chest.

Objection.—Opposed by the medical members of the Committee, on account of the compression of the upper part of the chest.

15. *Mr. Fyfe's Plan*.—A framed pack with straight iron rods projecting from the top and passing over the shoulders; leathern straps run from these to the bottom of the knapsack.

Objection.—Tried at Chatham and found to press very uncomfortably on the shoulders.

16. *Mr. Silver's Plan*.—A leathern yoke is fitted to the upper part of a framed pack, and is intended to rest on the shoulders.

Objection.—The yoke does not fit all men; in some cases it fits well, in others it is useless, in some inconvenient. As it would have to be cut carefully to fit the back of every wearer, the advantage gained is not commensurate with the cost and trouble.

17. *Mr. Truss's Plan*.—Two strong metal rods hook on to the top of the pack and then pass upon and rest, by means of curved padded plates, on the shoulders; then passing forward, are screwed into a strong ring in front of the chest; thence a single rod passes to the waist-belt. The rods nowhere touch on or compress the chest.

Advantages.—The weight is thrown fairly on the tops of the shoulders and is very easily carried; there is no compression anywhere.

Disadvantages.—The apparatus is awkward and cumbrous, and although strong it is quite possible that it might be broken. These objections are fatal to its introduction into the army, but it has been referred to Dr. Longmore to see if it can be made use of in the carriage of the "Field Companion" of the Army Hospital Corps.

18. *Colonel Baxter's Frame*.—Colonel Baxter, of the American army, has invented a wooden frame which, in principle, is similar to the frames sometimes used by glaziers in carrying glass.

The frame lies on the back and has straps above for holding the knapsack; below the pouch is carried in the same way. The frame itself is carried by two straps running over the shoulders and then to the bottom of the frame, which is so low down that the armpits are quite cleared; the two straps are connected by a cross breast strap to remove all risk of pressure on the armpits. Below a broad strap rests on the loins, on which a portion of the weight is thus thrown.

The plan is mechanically a very good one, but is objectionable on account of the possibility and indeed probability of the breaking of the frame. This renders it quite inadmissible.

19. *Havresac lit militaire*.—Under this name a French invention has been brought to the notice of the committee, in which, however, no new principles of carriage are introduced. The idea is simply to attach to the knapsack a waterproof sheeting which may be spread out and used as a bed, while the pack serves as a pillow.

The length of the waterproof is 3 ft. 6 $\frac{3}{4}$ in., and with the pack the total length is 4 ft. 8 in. The waterproof reaches to just below the hips; this plan would no doubt save the soldier to a certain extent, but in our opinion not sufficiently. We do not doubt the importance of the object, but question whether this is the best way of attaining it.

20. *Havresac lit*.—This invention is somewhat similar to the last, but is not intended for soldiers.

A bag is attached to a waterproof which forms either a sheet to be placed on the ground, or which can make a sort of coat to protect from rain. The whole thing is carried by a strap over the shoulder like the common havresac. This is proposed for officers. It is a good attempt but does not go far enough; the arms are quite unprotected. If the covering were more complete the plan might be a great service, but some better mode of carrying the sheet and bag would have to be adopted.

No. 5.

LETTER FROM PROFESSOR LONGMORE.

Royal Victoria Hospital, Netley,
July 22, 1865.

SIR,

I HAVE the honour to report that I have lately been trying the manner in which the "Medical Field Companion" and tin water-bottle (see page 238 of Medical Regulations) will have to be worn in case of troops being sent on active service in Europe. I find that the "Companion" cannot be put to its intended use when the knapsack is worn also; and as I am not aware that any provision has been made for the conveyance of the knapsack of the orderly by whom the "Medical Field Companion" is to be carried, I have thought it right to call your attention to the subject.

The manner in which this very useful small case of medicines, &c. is slung across the chest, in connexion with the knapsack itself, might perhaps be a subject proper for the consideration of the Knapsack Com-

mittee, of which Inspector-General Dr. Logan is a member.

In the medical history of the late war in China, by Inspector-General Dr. Muir, C.B., the "Field Companions" are described as "unexceptionable" and "invaluable" (see Army Medical Reports, 1860, page 394). But in China the men did not wear their knapsacks with the "Field Companions," as they would, I presume, be required to do in European campaigning.

I have had two photographs taken to indicate the manner in which the knapsack interferes with the use of the "Field Companion."

No. 1 photograph shows the "Companion" closed, and as it is carried when not in use. The strap over the left shoulder stands out from the back, its direction depending upon the manner in which it is attached to the "Companion."

No. 2 photograph shows the "Companion" after it has been brought round to the front and opened for issue of any of its contents.

When the knapsack is worn, the strap over the left shoulder is found to be so tightly pressed towards the back that the sliding movement which is necessary in order to bring the "Companion" to the front is prevented.

If the greatcoat and a few field necessities wrapped in it could be worn in the fashion of a knapsack, but without the knapsack itself, the strap of the "Field Companion" would not then be so tightly pressed as to impede its movement to the front. But as the greatcoat, when not worn on the knapsack, is now to be carried rolled, it was found on trial that the projecting of the roll in front was a source of incon-

venience by preventing the man from looking fairly into the part of the "Companion" near the waist-belt.

When the greatcoat is worn over the opposite shoulder, the ends of the roll interfere with the movement of the "Companion" from back to front, and *vice versâ*.

In the photograph the sergeant-major is represented wearing his havresac and sword, and carrying the water-bottle, in addition to the "Medical Field Companion."

I have, &c.

(Signed) T. LONGMORE,

Dep. Insp. General.

The Director General of the Army
Medical Department.

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